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(PCT Rule 61.2)

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Applicant VIGHOLM, Bo	

1. The designated Office is hereby notified of its election made:

☒ in the demand filed with the International Preliminary Examining Authority on:
 22 May 2001 (22.05.01)

☐ in a notice effecting later election filed with the International Bureau on:

2. The election ☒ was
☐ was not

made before the expiration of 19 months from the priority date or, where Rule 32 applies, within the time limit under Rule 32.2(b).

The International Bureau of WIPO 34, chemin des Colombettes 1211 Geneva 20, Switzerland Facsimile No.: (41-22) 740.14.35	Authorized officer Nestor Santesso Telephone No.: (41-22) 338.83.38
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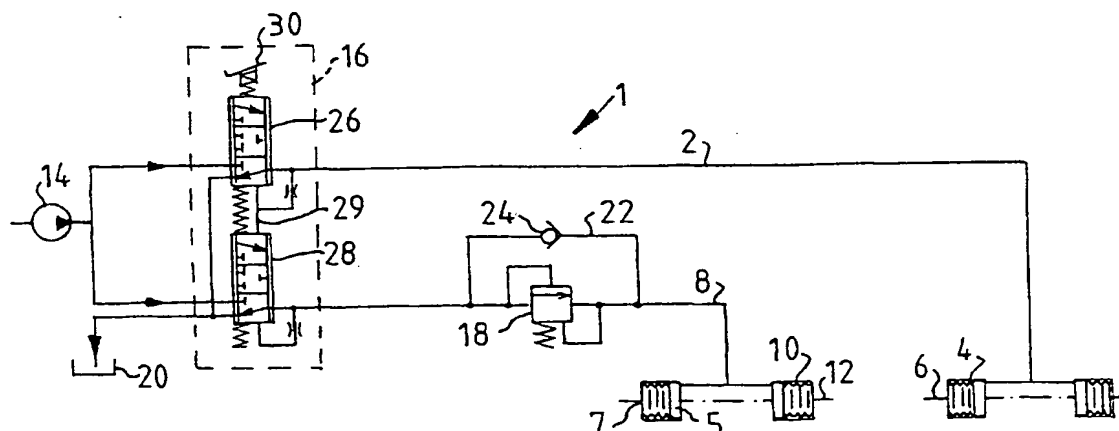
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(74) Agents: **STENSTRÖM, Jesper et al.; Albihns Stockholm AB, Box 5581, S-114 85 STOCKHOLM (SE).**

(54) Title: **BRAKE DEVICE FOR A CONSTRUCTION MACHINE**



(57) Abstract: The invention relates to a brake device (1) for a construction machine, comprising a first brake circuit (2), which is coupled to a first brake member (4) on a first wheel axle (6) of the machine, a second brake circuit (8), which is coupled to a second brake member (10) on a second wheel axle (12) of the machine, the first and second brake circuits (2, 8) being independent of one another, a pressure source (14) for hydraulic oil, which is coupled to the first and second brake circuits (2, 8), and a brake valve (16, 16'), which is coupled to the first and second brake circuit (2, 8), which brake valve (16, 16') is designed to control the hydraulic oil from the pressure source (14) to the brake members (4, 10) on the wheel axles (6, 12). The first or second brake circuit (2, 8) comprises limiting elements (18, 42'), which limit the pressure and/or flow of hydraulic oil when the brake valve (16, 16') controls the hydraulic oil from the pressure source (14) to the brake members (4, 10) on the wheel axles (6, 12).

1/3

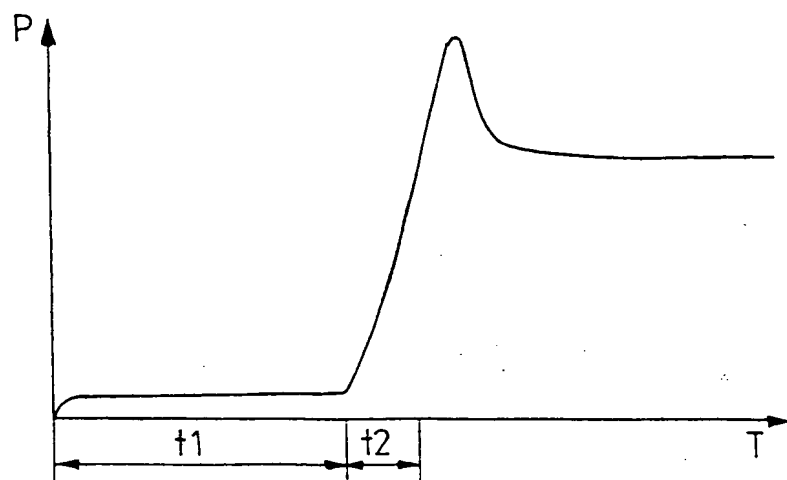


FIG.1

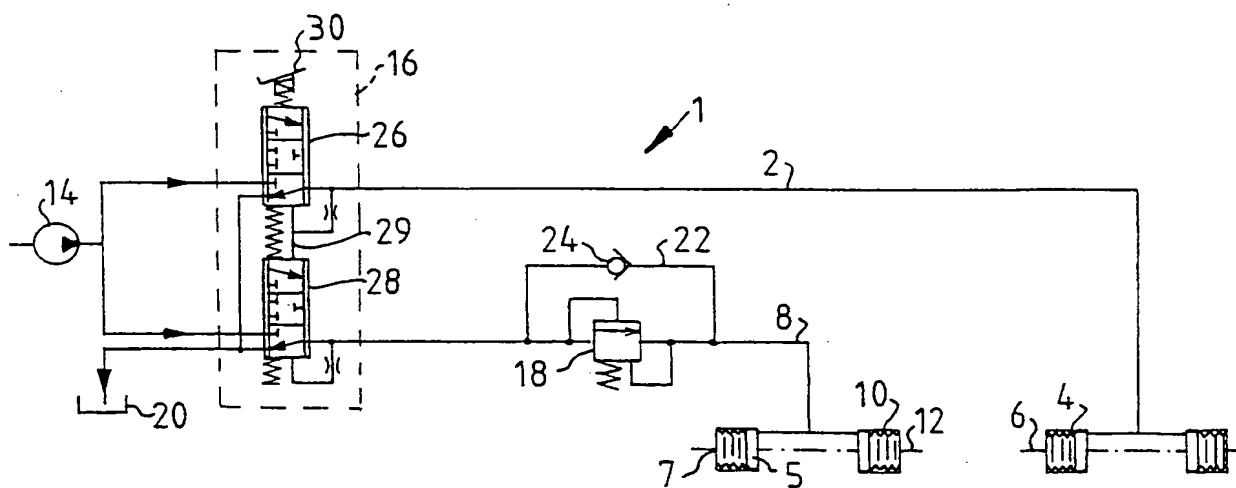
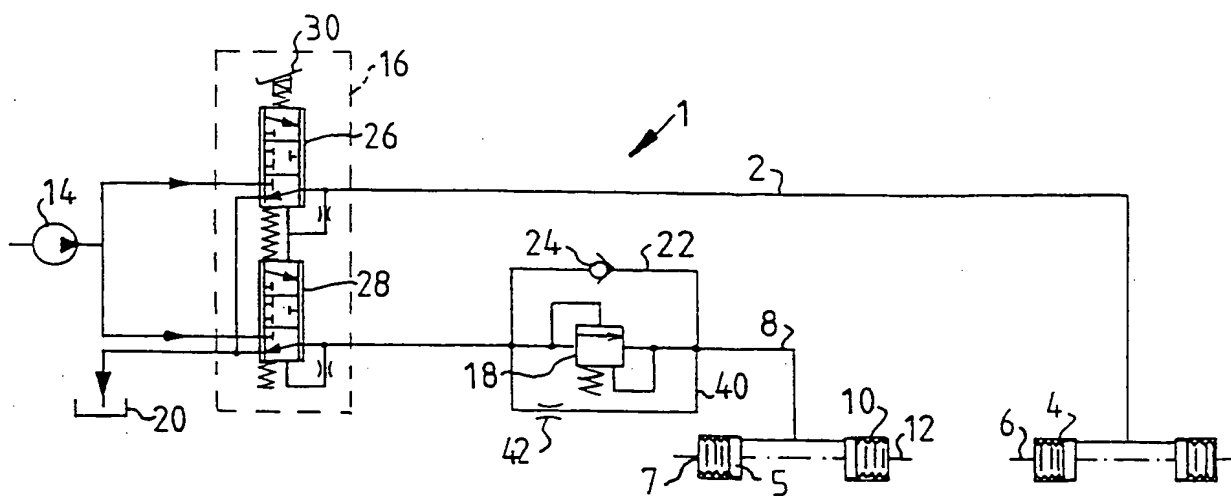
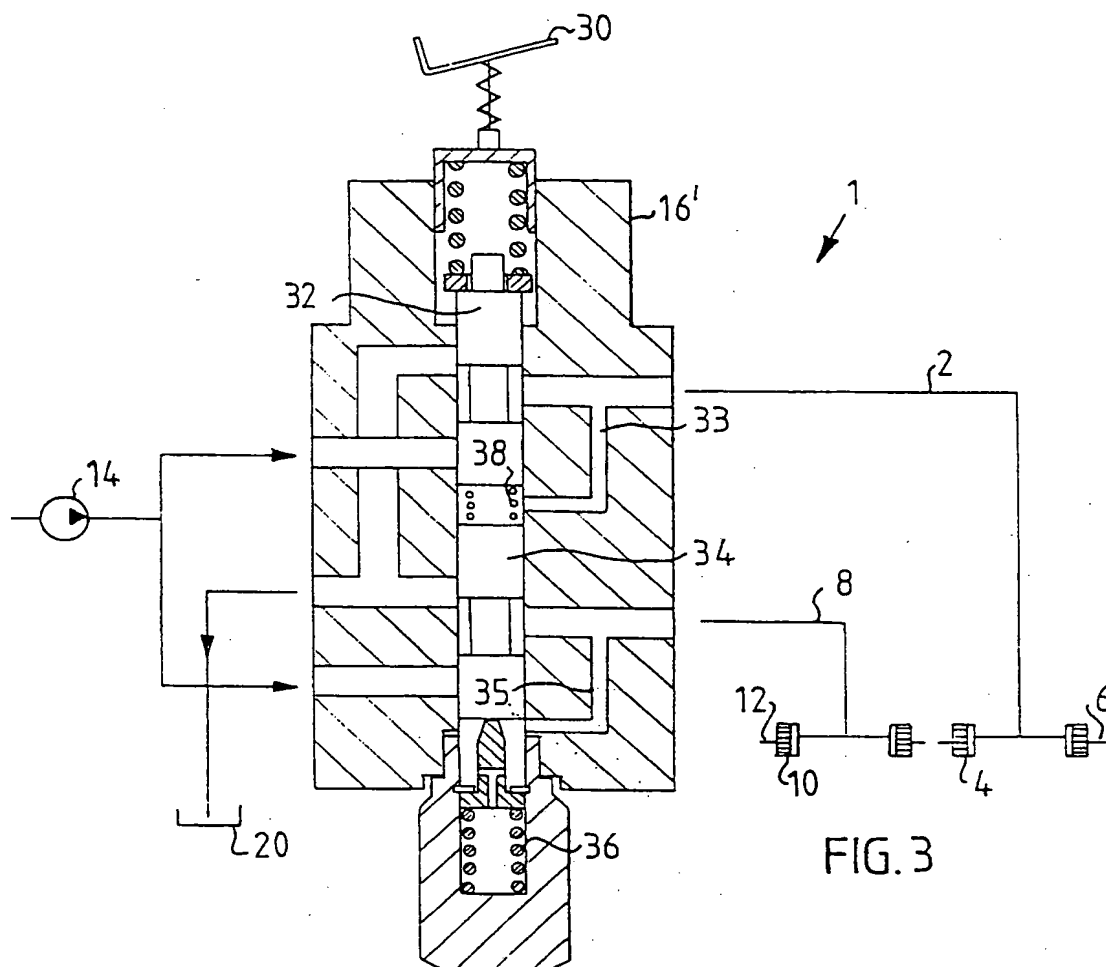


FIG.2

2 / 3



3 / 3

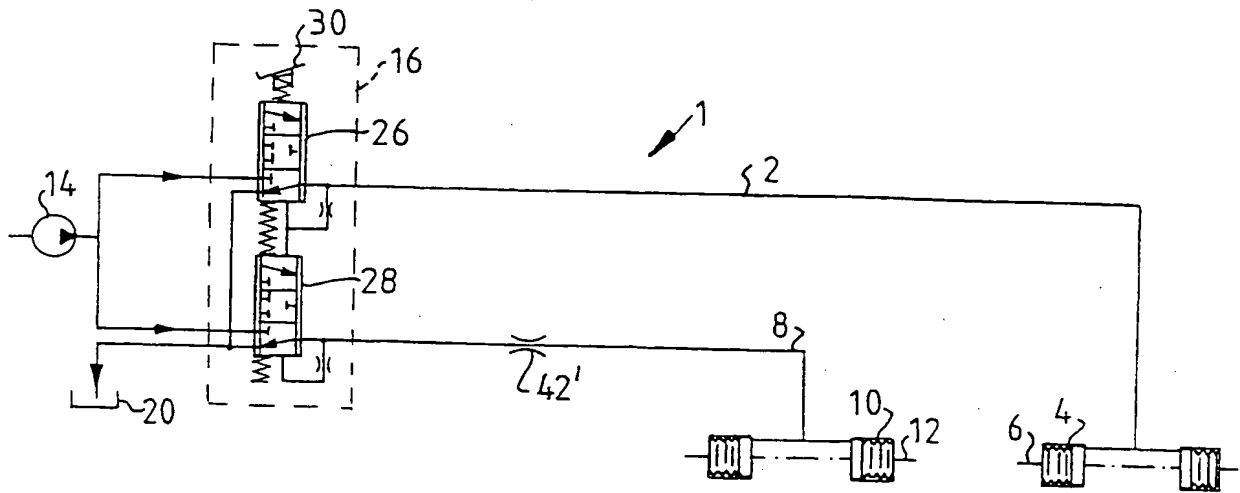


FIG. 5

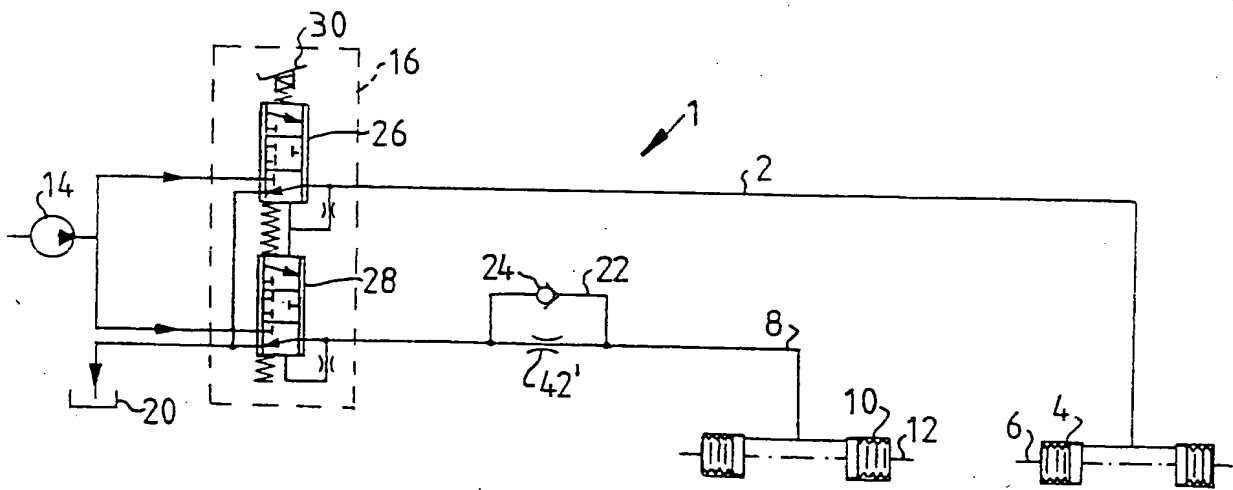


FIG. 6

Brake device for a construction machine

The present invention relates to a brake device for a construction machine, comprising a first brake circuit, which is coupled to a first brake member on a first wheel axle of the machine, a second brake circuit, which is coupled to a second brake member on a second wheel axle of the machine, the said first and second brake circuits being independent of one another, a pressure source for hydraulic oil, which is coupled to the first and second brake circuit, and a brake valve, which is coupled to the first and second brake circuit, the brake valve being designed to control the hydraulic oil from the pressure source to the brake members on the wheel axles.

A construction machine, such as a wheeled loader or a dumper truck, must be equipped with brakes that are suited to the varying characteristics of the machine. In one extreme case a fully loaded machine must be powerfully retarded and in another extreme case the same machine without a load must be gently braked. In order to enable the driver of the machine to handle the machine, the retardation of the machine must feel controllable and manageable under all operating conditions. From an ergonomic standpoint, the force applied to the brake pedal by the driver must be the minimum possible. The control travel of the brake pedal must also be the minimum possible.

The brake systems hitherto fitted on construction machines comprise two or more independent brake circuits, which are controlled by a brake valve. The brake valve is coupled to the brake pedal, which opens the valve when a force is applied by the driver, so that hydraulic oil under pressure flows to brake members, which are arranged on machine wheel axles or wheels. The brake members comprise a piston, which is moved under the pressure of the hydraulic oil and presses a brake lining against a brake disc. When the driver releases the brake pedal the pressure on the

- 2 -

brake piston 5 ceases and the brake lining 7 is moved into an initial position by means of return springs.

When the driver presses the brake pedal, thereby opening the brake valve, it takes a certain time to move the
5 brake piston 5 from the initial position to the position assumed by the brake piston 5 when the brake lining is bearing against the brake disc. This time is called the brake application time. Once the brake piston has reached
10 this latter position the pressurization of the hydraulic oil against the brake piston commences, which leads to a powerful excess pressure surge in the form of a pressure pulse in the hydraulic oil. This excess pressure surge gives rise to a brake shock, that is to say a powerful retardation of the machine in a short time, which the driver
15 experiences as a jerk. The excess pressure surge also results in components of the brake members being exposed to heavy stresses, which among other things generates noise. The jerking and the noise are experienced by the driver of the machine as irritations.

20 In gentle braking the force on the brake pedal must be slight. If the machine is travelling on an uneven surface, so that the machine jumps and shakes, it becomes difficult for the driver to control the brake device by means of the brake pedal in order to achieve gentle braking.
25 The retardation of the machine will then vary, so that the driver perceives the brake device as difficult to control. In order to achieve good controllability of the brake device, the brake application time must be as short as possible and the excess pressure surge as small as possible.
30 A short brake application time is achieved by means of a large flow of hydraulic oil through the brake valve, but the greater the flow of hydraulic oil, the greater the excess pressure surge becomes.

An object of the present invention is to produce a
35 brake device, which is adapted to the various operating

conditions of a construction machine, so that machine jerking and noise are avoided when braking the machine.

Another object of the invention is to produce a brake device that exhibits little sensitivity in gentle
5 braking.

This is achieved by a brake device of the type specified in the introductory part, in which a limiting element arranged in the first or second brake circuit limits the pressure and/or flow of the hydraulic oil when the brake
10 valve is controlling the hydraulic oil from the pressure source to the brake members on the wheel axles.

The limiting element helps to reduce the braking action on the one wheel axle at the commencement of the braking sequence, which thereby reduces the sensitivity of
15 the brake device. When the driver depresses the brake pedal gently in order to brake gently, only a small flow of hydraulic oil, if any, will occur in the brake circuit that is fitted with the limiting element, while a large flow of hydraulic oil will flow in the brake circuit that is not
20 fitted with a limiting element. Once a certain time has elapsed or once the hydraulic oil pressure has reached a predetermined limit, the pressure applied to the brake member on the wheel axle that had reduced braking action from the outset will increase the braking action on that
25 wheel axle. In the event of emergency-stop braking, for example, all wheel axles of the vehicle will be braked immediately when the driver presses the brake pedal.

The invention will be explained in more detail below with the aid of embodiments shown in the figures attached,
30 in which

Fig. 1 shows the hydraulic pressure as a function of the time taken to activate a known brake device,

35 Fig. 2 shows a first embodiment of a brake device according to the present invention,

Fig. 3 shows a brake valve for the brake device according to the present invention,

5 Fig. 4 shows a second embodiment of a brake device according to the present invention,

Fig. 5 shows a third embodiment of a brake device according to the present invention,

10

Fig. 6 shows a fourth embodiment of a brake device according to the present invention.

Figure 1 contains a graph showing how the hydraulic
15 pressure varies when a known brake device is activated. The horizontal axis gives the time T and the vertical axis gives the pressure P . As stated in the introductory part of the specification, it takes a certain time t_1 to move a brake piston from an initial position to a position assumed by the
20 brake piston when a brake lining, against which the brake piston presses, is bearing against a brake disc. When the brake piston is in this latter position the pressurization of the hydraulic oil against the brake piston commences, which leads to a powerful excess pressure surge in the form
25 of a pressure pulse in the hydraulic oil. This pressurization takes place over a period of time t_2 . The excess pressure surge gives rise to a brake shock, that is to say a powerful retardation of the machine in a short time, which the driver experiences as a jerk. It has also
30 emerged that noise is generated in the brake device as a result of the said excess pressure surge.

Figure 2 shows a first embodiment of a brake device
1 according to the present invention. The brake device 1 comprises a first brake circuit 2, which is coupled to a
35 first brake member 4 on a first wheel axle 6 of a construction machine. The brake member 4 comprises a brake

- 5 -

piston 5 fitted to each wheel, which piston by way of one or more brake linings 7 interacts with a brake disc (not shown) connected to the wheel axle 6. The brake device 1 also comprises a second brake circuit 8, which is coupled to a second brake member 10 on a second wheel axle 12 of the machine. After application of the brake device the first and second brake circuits 2, 8 are independent of one another, which means that the pressure in one circuit 2, 8 does not affect the hydraulic oil pressure in the other circuit 2, 8. If one circuit 2, 8 fails, the construction machine can still be braked by means of the other circuit 2, 8. A pressure source 14 for hydraulic oil is coupled to the first and second brake circuit 2, 8. The pressure source 14 may take the form, for example, of a hydraulic pump and/or one or more hydraulic accumulators (not shown). A brake valve 16 is coupled to the first and second brake circuit 2, 8, which brake valve 16 is designed to control the hydraulic oil from the pressure source 14 to the brake members 4, 10 on the wheel axles 6, 12. A limiting element in the form of a sequence valve 18 is arranged in the second brake circuit 8.

When the brake valve 16 controls the hydraulic oil from the pressure source 14 to the brake members 4, 10 on the wheel axles 6, 12, the sequence valve 18 will limit the hydraulic oil flow to the second brake member 10 if the pressure of the hydraulic oil falls below a predetermined pressure. This limiting may mean that little hydraulic oil, if any, flows through the sequence valve 18. The sequence valve 18 opens when the hydraulic oil pressure reaches a predetermined pressure, so that a large hydraulic oil flow through the sequence valve 18 occurs. The function of the sequence valve 18 can thus be likened to the function of a pressure-relief valve.

When the brake device 1 is activated, the hydraulic oil in the brake members 4, 10 will be drained, which means that the hydraulic oil will flow in the direction away from

- 6 -

the brake members 4, 10 to the brake valve 16 and on to a tank 20. In order to achieve this, a first bypass line 22 is connected over the sequence valve 18, so that hydraulic oil is allowed to bypass the sequence valve 18. A non-
5 return valve 24 is arranged in the first bypass line 22, so that hydraulic oil is prevented from flowing through the first bypass line 22 in the direction towards the second brake member 10.

According to a first embodiment the brake valve 16
10 comprises a first and second valve 26, 28, which are acted upon by a brake pedal 30. When the brake pedal 30 is depressed, the first and second slide valves 26, 28 are opened, so that hydraulic oil flows from the pressure source 14 towards the first and second brake members 4, 10. It is
15 preferably the pressure in the first brake circuit 2 that influences the opening of the second slide valve 28, which is indicated by a duct 29 between the first brake circuit 2 and the second slide valve 28.

Alternatively, the first and second slide valves 26,
20 28 together with the sequence valve 18 and the first bypass line 22 with the non-return valve 24 may be replaced by a brake valve 16', as shown in figure 3. The said brake valve 16' comprises a first slide 32, which controls the flow of hydraulic oil in the first brake circuit 2, and a second
25 slide 34, which controls the flow of hydraulic oil in the second brake circuit 8. The first slide 32 is arranged so as to control the second slide 34, so that the second slide 34 opens the second brake circuit 8 when the pressure in the first brake circuit 2 has reached a predetermined pressure.
30 The said predetermined pressure is determined by the spring force of a first spring 36 of the brake valve 16'. The first slide 32 is connected to the brake pedal 30 and when the brake pedal 30 is depressed, the first slide 32 will be displaced in the brake valve 16', so that the first brake
35 circuit 2 is opened. A second spring 38, arranged between the first and second slide 32, 34, ensures that the second

- 7 -

slide 34 is not displaced by the first slide 32 from the outset. When the first slide 32 has been displaced so far that the first circuit 2 has been opened, the hydraulic oil in the first branch line 33 to the circuit 2 will pressurize the space between the slides 32, 34. When the pressure in the first circuit 2 overcomes the force of the first spring 36, which acts on the second slide 34, the second slide 34 will open the second circuit 8. A second branch line 35 in the second circuit 8 carries hydraulic oil to the end of the second slide 34, which faces the first spring 36. When the pressure in the second circuit 8 together with the force from the first spring 36 overcome the pressure in the first circuit 2, the second slide 34 will close the second circuit 8. The pressure in the second circuit 8 will thereby become lower than the pressure in the first circuit 2. The difference between the pressure in the first and second circuit 2, 8 depends upon the magnitude of the spring force of the first spring 36. The first spring 36 will thereby function as a limiting element.

If the brake pedal 30 is only depressed a short way, in order to undertake gentle braking, only the first wheel axle 6 will be braked. When braking harder, the force of the first spring 36 must be overcome, so that both of the brake circuits 2, 8 are opened, which means that both of the wheel axles 6, 12 are braked. If one of the circuits 2, 8 should fail and hydraulic pressure in one of the circuits 2, 8 be absent when the brake device 1 is applied, the brake pedal 30 can be depressed to such a degree that the second spring 38 is compressed, which means that the second slide 34 will also be displaced, so that the second brake circuit 8 is opened.

Figure 4 shows a second embodiment of the invention. In this embodiment a second bypass line 40 is arranged over the sequence valve 18. A restrictor valve 42, which means that a limited flow of hydraulic oil can always bypass the sequence valve 18, is arranged in the second bypass line 40.

- 8 -

By means of the limited hydraulic oil flow, the second brake member 10 will be slowly activated and will brake the second wheel axle 12 by gentle braking when the pressure of the hydraulic oil does not attain the predetermined pressure at which the sequence valve 18 opens. Retarded braking of the second wheel axle 12 is therefore achieved.

According to a third embodiment, which is shown in figure 5, it is feasible to provide only the second brake circuit 8 with a restrictor valve 42', so that retarded braking of the second wheel axle 12 occurs. The restrictor valve 42' here constitutes a limiting element. In this way brake shock is prevented in gentle braking of the machine. It is also feasible, according to a fourth embodiment in figure 6, to arrange the first bypass line 22 with a non-return valve 24 over the restrictor valve 42' in the second brake circuit 8. This achieves rapid draining of the second brake member 10 when the brake device 1 is deactivated.

A brake device 1 with two brake circuits 2, 8 has been described above. It is possible, however, to design the brake device 1 with three or more brake circuits. It is also possible to arrange the limiting element 18, 42' in the first brake circuit 2 rather than the second brake circuit 8. The first wheel axle 6 may be a front axle and the second wheel axle 12 may be a rear axle of the machine, or vice versa.

Claims

1. Brake device for a construction machine, comprising a first brake circuit (2), which is coupled to a first brake member (4) on a first wheel axle (6) of the machine, a second brake circuit (8), which is coupled to a second brake member (10) on a second wheel axle (12) of the machine, the first and second brake circuits (2, 8) being independent of one another, a pressure source (14) for hydraulic oil, which is coupled to the first and second brake circuit (2, 8), and a brake valve (16, 16'), which is coupled to the first and second brake circuit (2, 8), which brake valve (16, 16') is designed to control the hydraulic oil from the pressure source (14) to the brake members (4, 10) on the wheel axles (6, 12), **characterized by** a limiting element (18, 36, 42') arranged in the first or second brake circuit (2, 8), which element limits the pressure and/or flow of hydraulic oil when the brake valve (16, 16') controls the hydraulic oil from the pressure source (14) to the brake members (4, 10) on the wheel axles (6, 12).
2. Brake device according to Claim 1, **characterized in that** the limiting element comprises a sequence valve (18), which opens when the hydraulic oil pressure reaches a predetermined pressure.
3. Brake device according to either of Claims 1 and 2, **characterized in that** the limiting element comprises a restrictor valve (42'), which limits the flow of hydraulic oil.
4. Brake device according to either of Claims 2 and 3, **characterized in that** a first bypass line (22) is connected over the limiting element (18, 42') so that hydraulic oil is allowed to bypass the limiting element (18, 42') and that a non-return valve (24) is arranged in the first bypass line

- 10 -

(22), so that hydraulic oil is prevented from flowing through the first bypass line (22) in the direction towards the brake member (4, 10).

5 5. Brake device according to Claim 2, **characterized in that** a second bypass line (40) is connected over the sequence valve (18) and that a restrictor valve (42) is arranged in the second bypass line (40), so that a limited flow of hydraulic oil can bypass the sequence valve (18).

10

6. Brake device according to Claim 1, **characterized in that** the brake valve (16') comprises the said limiting element (36).

15 7. Brake device according to Claim 6, **characterized in that** the brake valve (16') comprises a first slide (32), which controls the flow of hydraulic oil in the first brake circuit (2), and a second slide (34), which controls the flow of hydraulic oil in the second brake circuit (8), which
20 first slide (32) is arranged so as to control the second slide (34), so that the second slide (34) opens the second brake circuit (8) when the pressure in the first brake circuit (2) has reached a predetermined pressure.

25 8. Brake device according to Claim 7, **characterized in that** the limiting element comprises a first spring (36), which acts on the second slide (34)

30 9. Brake device according to any of the preceding claims, **characterized in that** a brake pedal (30) coupled to the brake valve (16, 16') is arranged so as to control the brake valve (16, 16').

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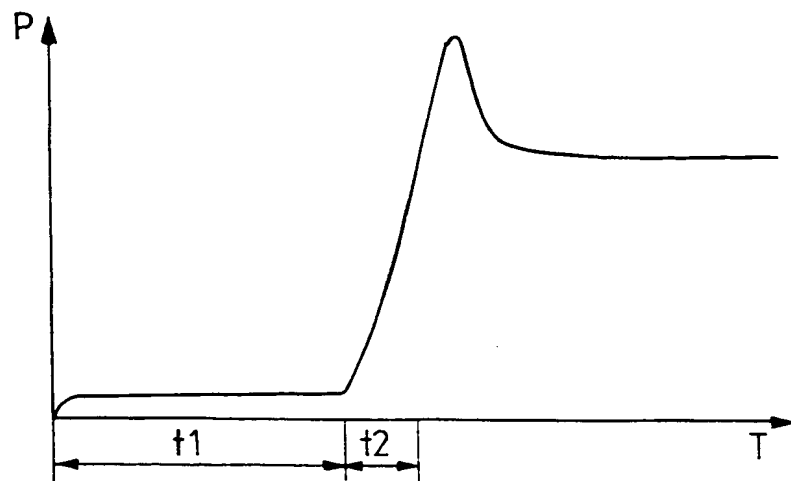


FIG.1

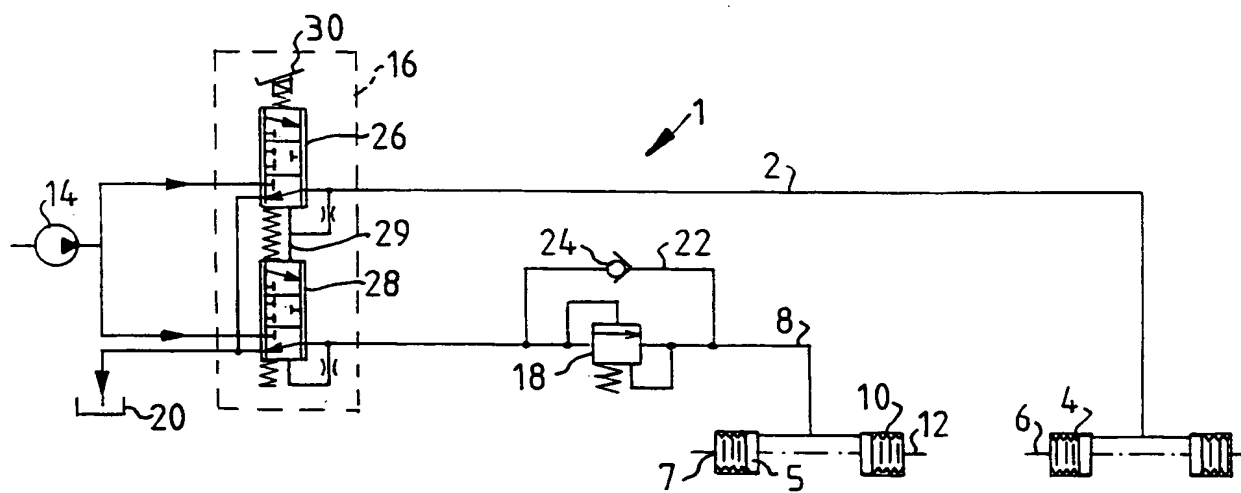


FIG.2

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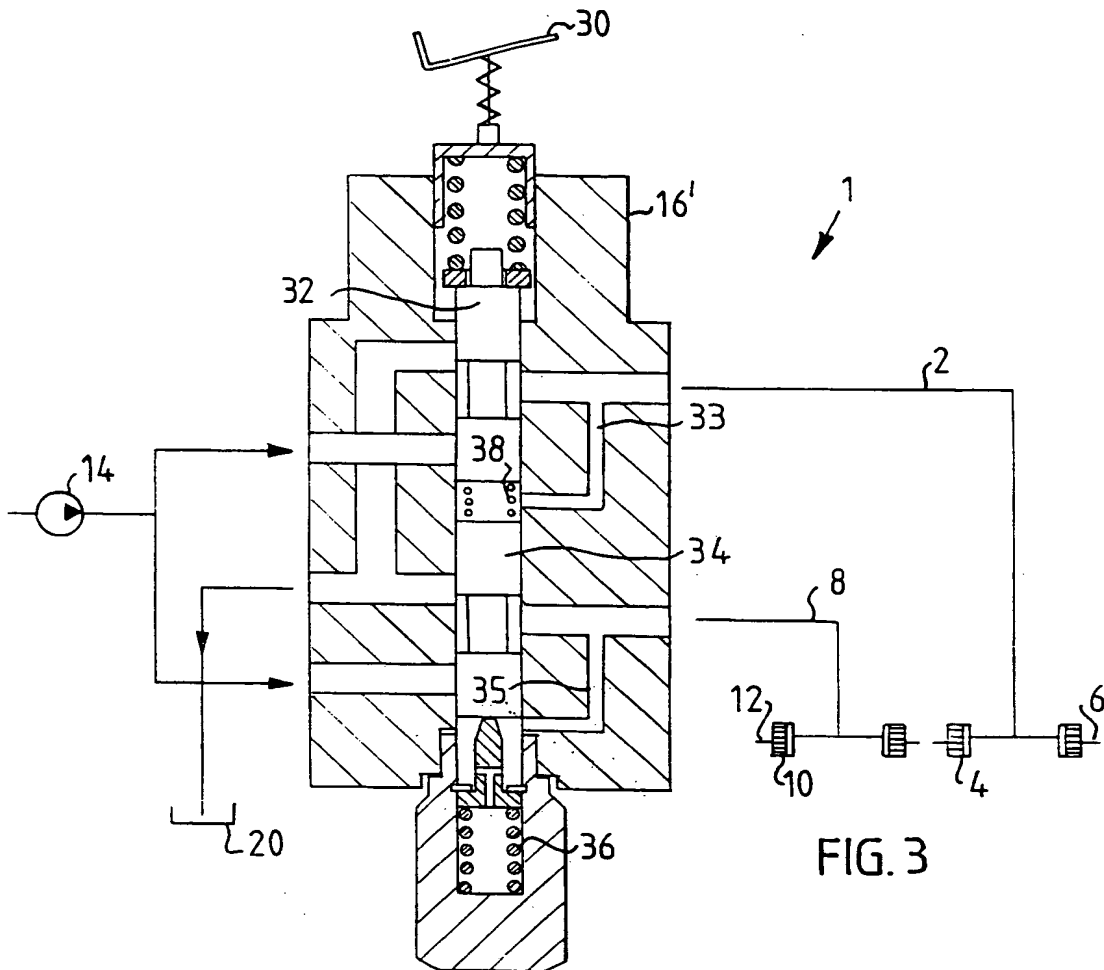


FIG. 3

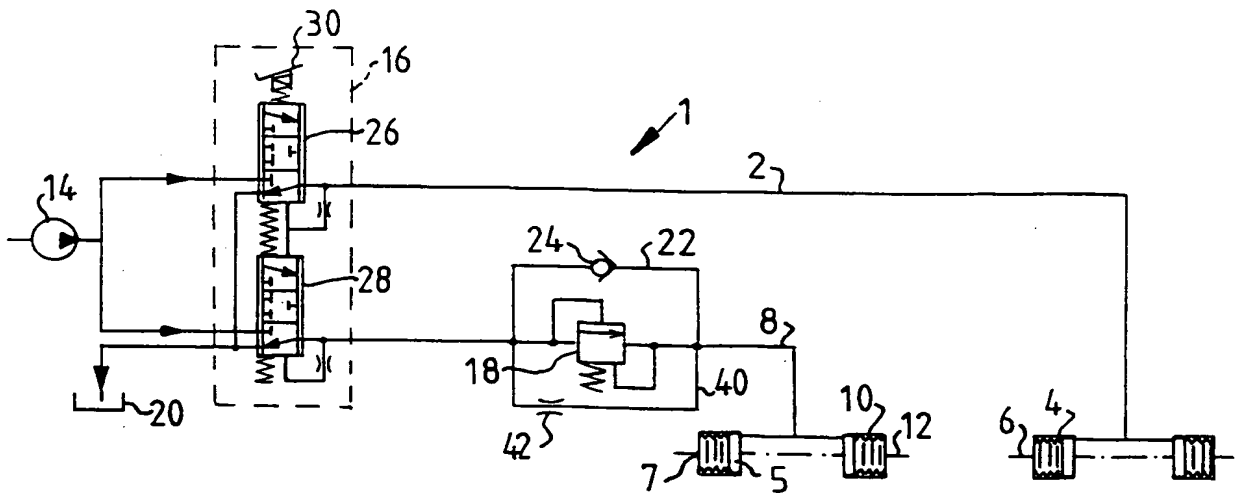


FIG. 4

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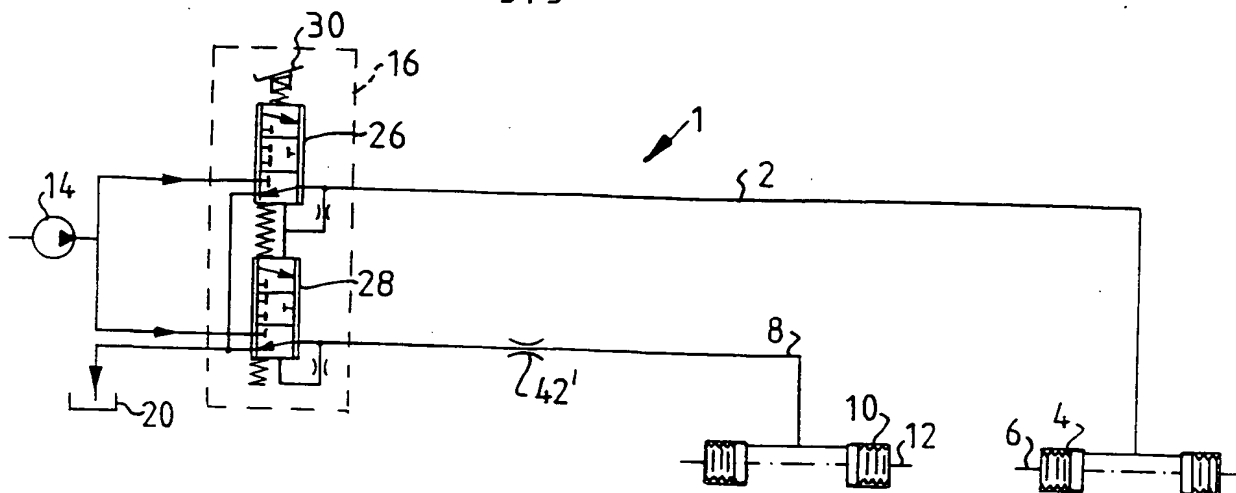


FIG. 5

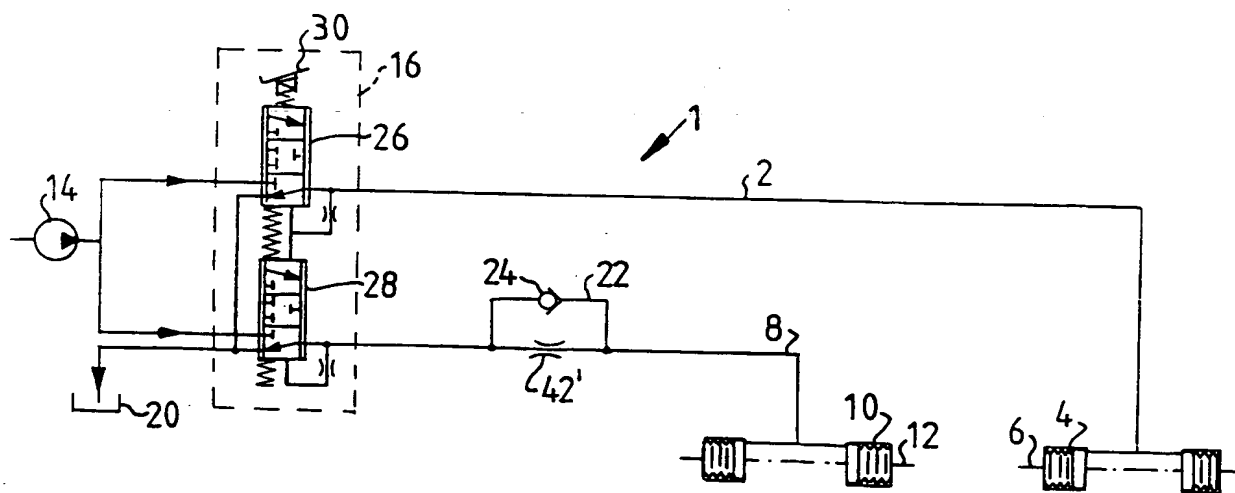


FIG. 6

Claims

1. Brake device for a construction machine, comprising
a first brake circuit (2), which is coupled to a first brake
5 member (4) on a first wheel axle (6) of the machine, a
second brake circuit (8), which is coupled to a second brake
member (10) on a second wheel axle (12) of the machine, the
first and second brake circuits (2, 8) being independent of
one another, a pressure source (14) for hydraulic oil, which
10 is coupled to the first and second brake circuit (2, 8), and
a brake valve (16, 16'), which is coupled to the first and
second brake circuit (2, 8), which brake valve (16, 16') is
designed to control the hydraulic oil from the pressure
source (14) to the brake members (4, 10) on the wheel axles
15 (6, 12), characterized by a limiting element (18, 36, 42')
arranged in the first or second brake circuit (2, 8), which
element limits the pressure and/or flow of hydraulic oil
when the brake valve (16, 16') controls the hydraulic oil
from the pressure source (14) to the brake members (4, 10)
20 on the wheel axles (6, 12).
2. Brake device according to Claim 1, characterized in
that the limiting element comprises a sequence valve (18),
which opens when the hydraulic oil pressure reaches a
25 predetermined pressure.
3. Brake device according to either of Claims 1 and 2,
characterized in that the limiting element comprises a
restrictor valve (42'), which limits the flow of hydraulic
30 oil.
4. Brake device according to either of Claims 2 and 3,
characterized in that a first bypass line (22) is connected
over the limiting element (18, 42') so that hydraulic oil is
35 allowed to bypass the limiting element (18, 42') and that a
non-return valve (24) is arranged in the first bypass line

- 10 -

(22), so that hydraulic oil is prevented from flowing through the first bypass line (22) in the direction towards the brake member (4, 10).

5 5. Brake device according to Claim 2, characterized in that a second bypass line (40) is connected over the sequence valve (18) and that a restrictor valve (42) is arranged in the second bypass line (40), so that a limited flow of hydraulic oil can bypass the sequence valve (18).

10

6. Brake device according to Claim 1, characterized in that the brake valve (16') comprises the said limiting element (36).

15 7. Brake device according to Claim 6, characterized in that the brake valve (16') comprises a first slide (32), which controls the flow of hydraulic oil in the first brake circuit (2), and a second slide (34), which controls the flow of hydraulic oil in the second brake circuit (8), which
20 first slide (32) is arranged so as to control the second slide (34), so that the second slide (34) opens the second brake circuit (8) when the pressure in the first brake circuit (2) has reached a predetermined pressure.

25 8. Brake device according to Claim 7, characterized in that the limiting element comprises a first spring (36), which acts on the second slide (34)

9. Brake device according to any of the preceding claims,
30 characterized in that a brake pedal (30) coupled to the brake valve (16, 16') is arranged so as to control the brake valve (16, 16').

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Applicant's or agent's file reference 62076		FOR FURTHER ACTION	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416)
International application No. PCT/PCT/SE00/02014	International filing date (day/month/year) 18.10.2000	Priority date (day/month/year) 26.10.1999	
International Patent Classification (IPC) or national classification and IPC ₇ B60T 08/18, B60T 11/24, B60T 15/34			
Applicant Volvo Wheel Loaders AB et al			

1.	This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.
2.	This REPORT consists of a total of <u>4</u> sheets, including this cover sheet. <input checked="" type="checkbox"/> This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT). These annexes consist of a total of <u>3</u> ⁴ sheets.
3.	This report contains indications relating to the following items: <ul style="list-style-type: none"> I <input checked="" type="checkbox"/> Basis of the report II <input type="checkbox"/> Priority III <input type="checkbox"/> Non-establishment of opinion with regard to novelty, inventive step and industrial applicability IV <input type="checkbox"/> Lack of unity of invention V <input checked="" type="checkbox"/> Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement VI <input type="checkbox"/> Certain documents cited VII <input type="checkbox"/> Certain defects in the international application VIII <input type="checkbox"/> Certain observations on the international application

Date of submission of the demand 22.05.2001	Date of completion of this report 14.02.2002
Name and mailing address of the IPEA/SE Patent- och registreringsverket Box 5055 S-102 42 STOCKHOLM Facsimile No. 08-667 72 88	Authorized officer Igor Gazdik/js Telephone No. 08-782 25 00

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.
PCT/PCT/SE00/02014

I. Basis of the report

1. With regard to the elements of the international application:*

- ☐ the international application as originally filed
- ☒ the description:
pages 1-7, as originally filed
pages _____, filed with the demand
pages _____, filed with the letter of _____
- ☒ the claims:
pages _____, as originally filed
pages 9-11, as amended (together with any statement) under article 19
pages _____, filed with the demand
pages _____, filed with the letter of _____
- ☒ the drawings:
pages 1-3, as originally filed
pages _____, filed with the demand
pages _____, filed with the letter of _____
- ☐ the sequence listing part of the description:
pages _____, as originally filed
pages _____, filed with the demand
pages _____, filed with the letter of _____

2. With regard to the language, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.

These elements were available or furnished to this Authority in the following language English which is:

- ☐ the language of a translation furnished for the purposes of international search (under Rule 23.1(b)).
- ☒ the language of publication of the international application (under Rule 48.3(b)).
- ☐ the language of the translation furnished for the purposes of international preliminary examination (under Rules 55.2 and/or 55.3).

3. With regard to any nucleotide and/or amino acid sequence disclosed in the international application, the international preliminary examination was carried out on the basis of the sequence listing:

- ☐ contained in the international application in written form.
- ☐ filed together with the international application in computer readable form.
- ☐ furnished subsequently to this Authority in written form.
- ☐ furnished subsequently to this Authority in computer readable form.
- ☐ The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.
- ☐ The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished.

4. ☐ The amendments have resulted in the cancellation of:

- ☐ the description, pages _____
- ☐ the claims, Nos. _____
- ☐ the drawings, sheet/fig _____

5. ☐ This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2 (c)).**

* Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are annexed to this report since they do not contain amendments (Rules 70.16 and 70.17).

** Any replacement sheet containing such amendments must be referred to under item I and annexed to this report.

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.

PCT/PCT/SE00/02014

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims	<u>1-12</u>	YES
	Claims		NO
Inventive step (IS)	Claims	<u>1-12</u>	YES
	Claims		NO
Industrial applicability (IA)	Claims	<u>1-12</u>	YES
	Claims		NO

2. Citations and explanations (Rule 70.7)

In the International Search Report, documents **WO 9721574 A1**, **DE 4320390 A1** and **DE 19624548 A1** are listed as category X document against various claims of the present application.

Document **WO 9721574 A1** features in claims 1-3, a dual brake circuit, each equipped with an isolation valve and non-return valve. The latter opens up in the direction from the high pressure source to wheel brakes. Each pressure line is provided with a check valve.

Document **DE 4320390 A1** features in claim 1 a multicircuit brake arrangement, whereby an aperture, placed in the inlet of the pressure medium is used to generate a pressure differential.

Document **DE 19624548 A1** features an independent brake circuit in which there is a pressure limiter for the maximum operating pressure and limiting the possibility of pressure build up beyond this value. The pressure limiter is an overpressure valve.

In response to the International search report the applicant submitted a set of amended claims according to Article 19. In claim 1, it is highlighted that the limiting element is adapted to limit the flow to the brake member up to a predetermined hydraulic oil pressure, and to open for a flow-through of hydraulic oil when the predetermined pressure is reached to achieve a delayed activation of the brake member. Claims 9-12 specify a method compliant with the brake device claimed in claims 1-8.

.../...

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.

PCT/PCT/SE00/02014

Supplemental Box

(To be used when the space in any of the preceding boxes is not sufficient)

Continuation of: Box V

By comparison with the content of the documents cited, it is thus obvious that the configuration of the braking device according to the amended claims differs significantly from the devices known previously.

The conclusion in the light of the amendments submitted is that, the invention claimed in claims 1-12 of this application is considered to be novel, it involves an inventive step, and is considered to have industrial applicability.

PATENT COOPERATION TREATY

06-08-2001

PCT

NOTIFICATION CONCERNING
AMENDMENTS OF THE CLAIMS(PCT Rule 62 and
Administrative Instructions, Section 417)

From the INTERNATIONAL BUREAU

To:

Swedish Patent Office
P.O. Box 5055
S-102 42 Stockholm
SUÈDE

Date of mailing (day/month/year)

26 July 2001 (26.07.01)

in its capacity as International Preliminary Examining Authority

International application No.

PCT/SE00/02014

International filing date (day/month/year)

18 October 2000 (18.10.00)

Applicant

VOLVO WHEEL LOADERS AB et al

The International Bureau hereby transmits a copy of the amendments to the claims under Article 19 together with any accompanying statement (Rule 62).

The International Bureau of WIPO
34, chemin des Colombettes
1211 Geneva 20, Switzerland

Facsimile No. (41-22) 740.14.35

Authorized officer

Nestor Santesso

Telephone No. (41-22) 338.83.38

PCT REQUEST

Original (for SUBMISSION) - printed on 16.10.2000 09:26:08 AM

62076

0	For receiving Office use only	
0-1	International Application No.	PCT/SE 0 0 / 0 2 0 1 4
0-2	International Filing Date	1 8 -10- 2000
0-3	Name of receiving Office and "PCT International Application"	The Swedish Patent Office PCT International Application
0-4	Form - PCT/RO/101 PCT Request	
0-4-1	Prepared using	PCT-EASY Version 2.91 (updated 01.07.2000)
0-5	Petition The undersigned requests that the present international application be processed according to the Patent Cooperation Treaty	
0-6	Receiving Office (specified by the applicant)	Swedish Patent Office (RO/SE)
0-7	Applicant's or agent's file reference	62076
I	Title of invention	BRAKE DEVICE FOR A CONSTRUCTION MACHINE
II	Applicant	
II-1	This person is:	applicant only
II-2	Applicant for	all designated States except US
II-4	Name	VOLVO WHEEL LOADERS AB
II-5	Address:	S-631 85 ESKILSTUNA Sweden
II-6	State of nationality	SE
II-7	State of residence	SE
III-1	Applicant and/or inventor	
III-1-1	This person is:	applicant and inventor
III-1-2	Applicant for	US only
III-1-4	Name (LAST, First)	VIGHOLM, Bo
III-1-5	Address:	Ostra Knall PL 1353 E S-635 08 ESKILSTUNA Sweden
III-1-6	State of nationality	SE
III-1-7	State of residence	SE

18-10-2000

2/4

PCT REQUEST

62076

Original (for SUBMISSION) - printed on 16.10.2000 09:26:08 AM

IV-1	Agent or common representative; or address for correspondence The person identified below is hereby/has been appointed to act on behalf of the applicant(s) before the competent International Authorities as:	agent
IV-1-1	Name	ALBIHNS [PATENTBYRÅ] STOCKHOLM AB
IV-1-2	Address:	Box 5581 S-114 85 STOCKHOLM Sweden
IV-1-3	Telephone No.	+46 8 59 88 72 00
IV-1-4	Facsimile No.	+46 8 59 88 73 00
IV-2	Additional agent(s)	additional agent(s) with same address as first named agent
IV-2-1	Name(s)	STENSTRÖM, Jesper; HELLBOM, Lars; HAMMAR, Ernst; LETTSTRÖM, Richard; FAGERLIN, Helene; LAGMAN, Sven
V	Designation of States	
V-1	Regional Patent (other kinds of protection or treatment, if any, are specified between parentheses after the designation(s) concerned)	AP: GH GM KE LS MW MZ SD SL SZ TZ UG ZW and any other State which is a Contracting State of the Harare Protocol and of the PCT EA: AM AZ BY KG KZ MD RU TJ TM and any other State which is a Contracting State of the Eurasian Patent Convention and of the PCT EP: AT BE CH&LI CY DE DK ES FI FR GB GR IE IT LU MC NL PT SE and any other State which is a Contracting State of the European Patent Convention and of the PCT OA: BF BJ CF CG CI CM GA GN GW ML MR NE SN TD TG and any other State which is a member State of OAPI and a Contracting State of the PCT
V-2	National Patent (other kinds of protection or treatment, if any, are specified between parentheses after the designation(s) concerned)	AE AG AL AM AT AU AZ BA BB BG BR BY BZ CA CH&LI CN CR CU CZ DE DK DM DZ EE ES FI GB GD GE GH GM HR HU ID IL IN IS JP KE KG KP KR KZ LC LK LR LS LT LU LV MA MD MG MK MN MW MX MZ NO NZ PL PT RO RU SD SE SG SI SK SL TJ TM TR TT TZ UA UG US UZ VN YU ZA ZW

See #12

PCT REQUEST

62076

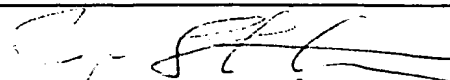
Original (for SUBMISSION) - printed on 16.10.2000 09:26:08 AM

V-5	Precautionary Designation Statement In addition to the designations made under items V-1, V-2 and V-3, the applicant also makes under Rule 4.9(b) all designations which would be permitted under the PCT except any designation(s) of the State(s) indicated under item V-6 below. The applicant declares that those additional designations are subject to confirmation and that any designation which is not confirmed before the expiration of 15 months from the priority date is to be regarded as withdrawn by the applicant at the expiration of that time limit.		
V-6	Exclusion(s) from precautionary designations	NONE	
VI-1	Priority claim of earlier national application		
VI-1-1	Filing date	26 October 1999 (26.10.1999)	
VI-1-2	Number	9903856-4	
VI-1-3	Country	SE	
VI-2	Priority document request The receiving Office is requested to prepare and transmit to the International Bureau a certified copy of the earlier application(s) identified above as item(s):	VI-1	
VII-1	International Searching Authority Chosen	Swedish Patent Office (ISA/SE)	
VII-2	Request to use results of earlier search; reference to that search		
VII-2-1	Date	26 October 1999 (26.10.1999)	
VII-2-2	Number	99/01411	
VII-2-3	Country (or regional Office)	SE	
VIII	Check list	number of sheets	electronic file(s) attached
VIII-1	Request	4 ✓	-
VIII-2	Description	7 ✓	-
VIII-3	Claims	2 ✓	-
VIII-4	Abstract	1 ✓	62076abs.txt
VIII-5	Drawings	3 ✓	-
VIII-7	TOTAL	17	
VIII-8	Accompanying items	paper document(s) attached	electronic file(s) attached
VIII-8	Fee calculation sheet	✓	-
VIII-16	PCT-EASY diskette	-	diskette
VIII-17	Other (specified):	Copy of ITS-report	-
VIII-17	Other (specified):	Copy of official action	-
VIII-18	Figure of the drawings which should accompany the abstract	2	
VIII-19	Language of filing of the international application	Swedish	

PCT REQUEST

62076

Original (for SUBMISSION) - printed on 16.10.2000 09:26:08 AM

IX-1	Signature of applicant or agent	
IX-1-1	Name	ALBIHNS PATENTBYRÅ STOCKHOLM AB
IX-1-2	Name of signatory	Jesper Stenström

FOR RECEIVING OFFICE USE ONLY

10-1	Date of actual receipt of the purported international application	18-10-2000
10-2	Drawings:	
10-2-1	Received ✓	
10-2-2	Not received	
10-3	Corrected date of actual receipt due to later but timely received papers or drawings completing the purported international application	
10-4	Date of timely receipt of the required corrections under PCT Article 11(2)	
10-5	International Searching Authority	ISA/SE
10-6	Transmittal of search copy delayed until search fee is paid	

FOR INTERNATIONAL BUREAU USE ONLY

11-1	Date of receipt of the record copy by the International Bureau	24 NOVEMBER 2000 (24.11.00)
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1/3

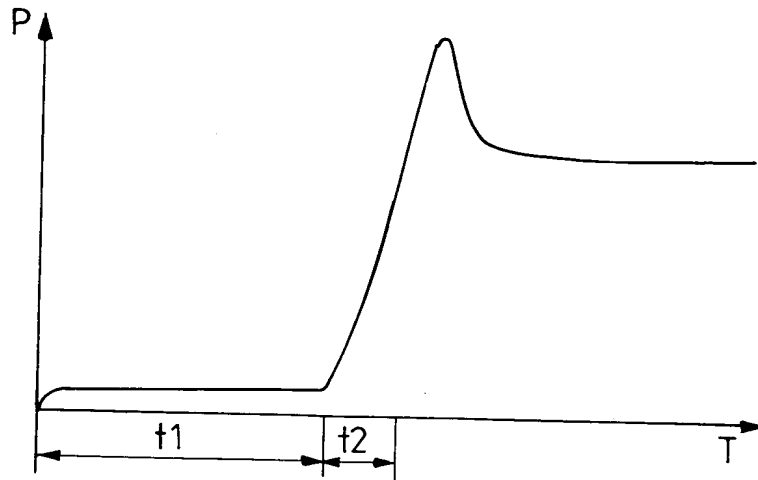


FIG.1

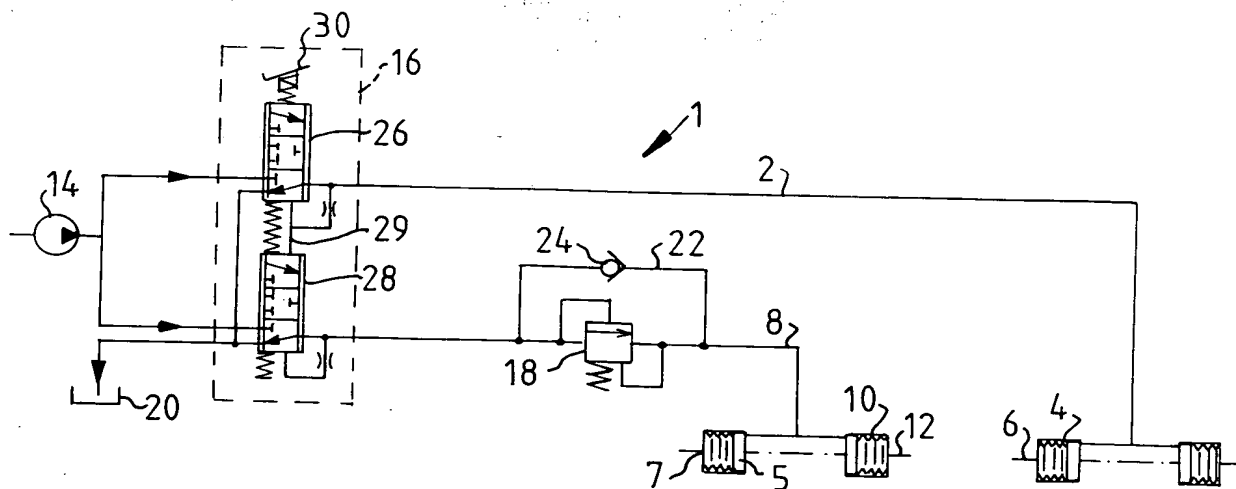


FIG.2

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2/3

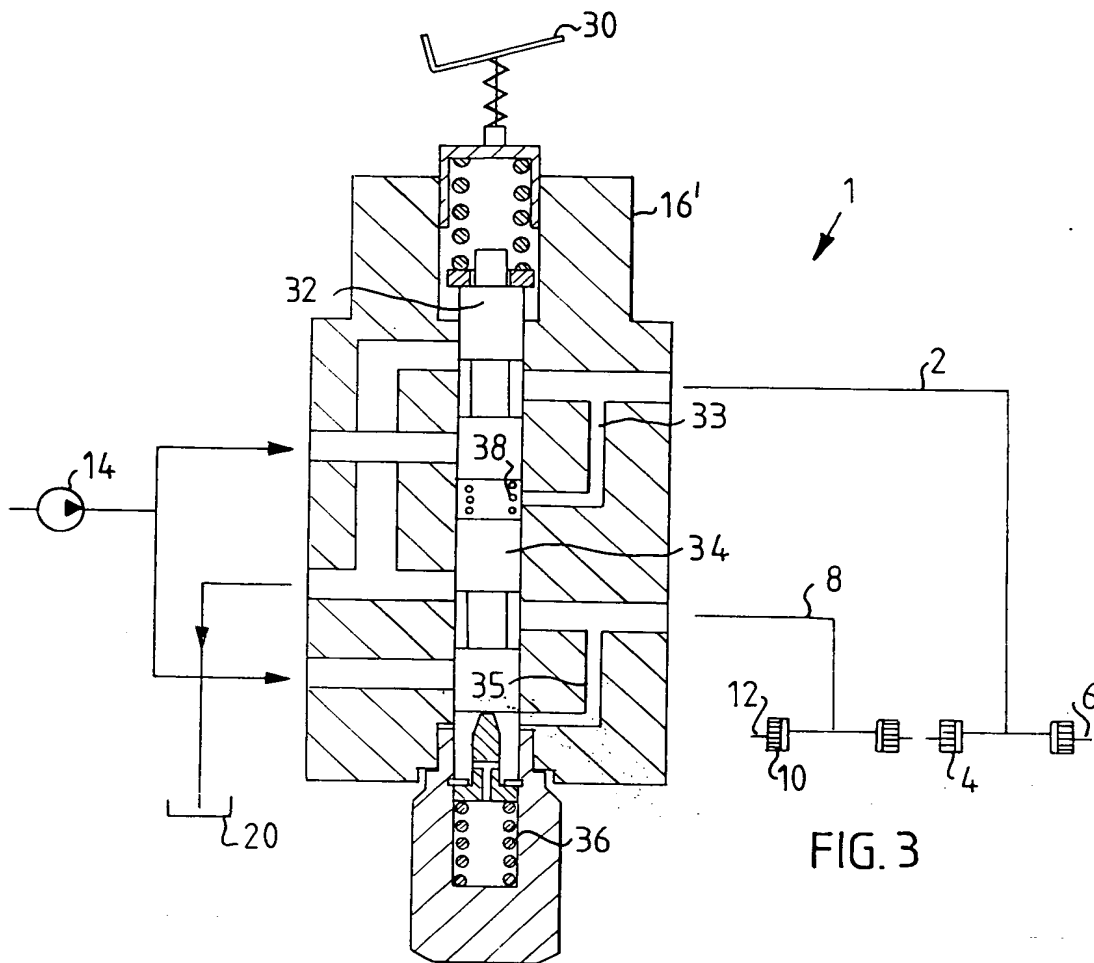


FIG. 3

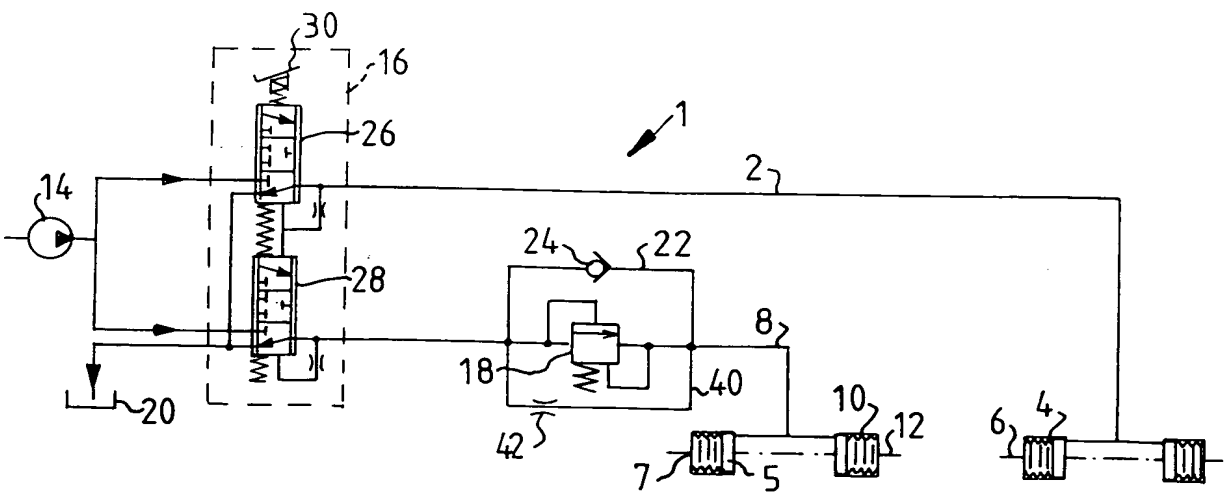
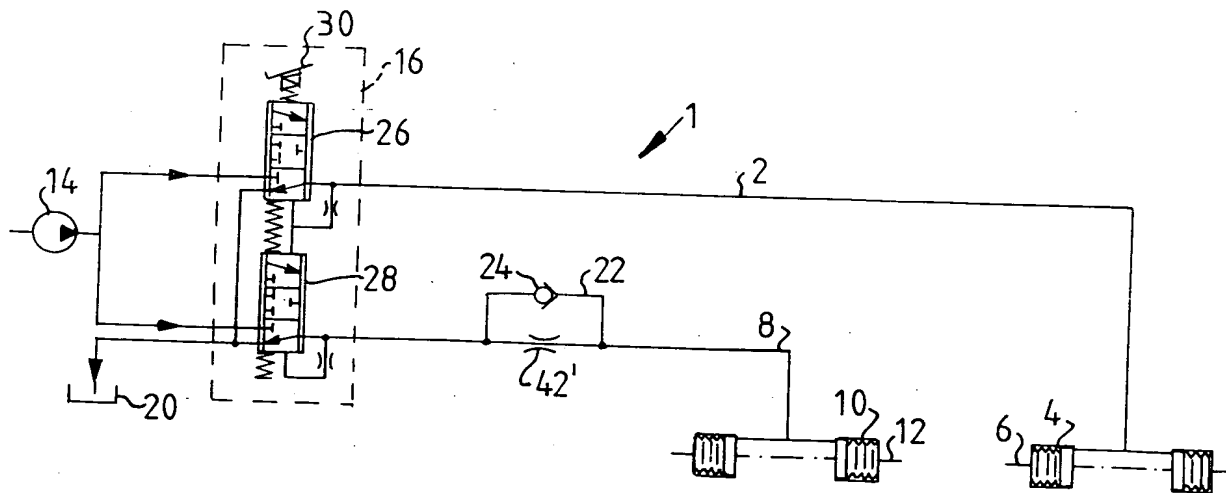
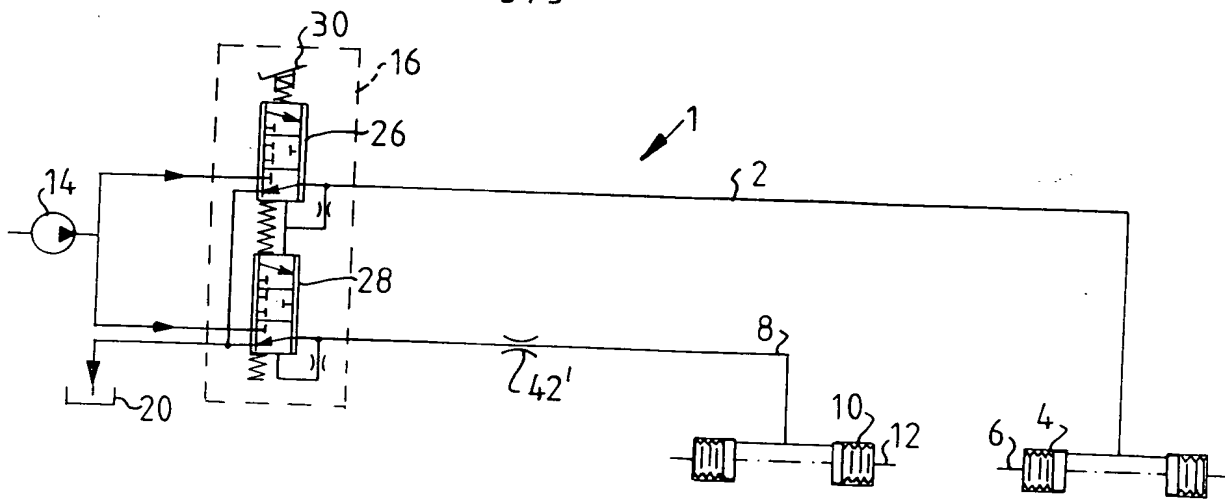


FIG. 4

22-12-2000

3 / 3



Bromsanordning för en entreprenadmaskin

Föreliggande uppfinning avser en bromsanordning för en entreprenadmaskin, innefattande en första bromskrets, som är kopplad till ett första bromsorgan vid en första
5 hjulaxel hos maskinen, en andra bromskrets, som är kopplad till ett andra bromsorgan vid en andra hjulaxel hos maskinen, vilka första och andra bromskretsar är oberoende av varandra, en tryckkälla för hydraulolja, som är kopplad till den första och andra bromskretsen, och en bromsventil, som är kopplad till den första och andra bromskretsen, vilken bromsventil är utformad att styra hydrauloljan från tryckkällan till broms-
10 organen vid hjulaxlarna.

En entreprenadmaskin, såsom en hjullastare eller en dumper, måste förses med bromsar, som är anpassade till maskinens varierande egenskaper. I ett ytterlighetsfall skall en fullastad maskin kraftigt retarderas och i ett annat ytterlighetsfall skall samma ma-
15 skin utan last mjukt inbromsas. För att maskinens förare skall kunna hantera maskinen måste retardationen av maskinen under alla driftsförhållanden kännas reglerbar och hanterlig. Ur ergonomisk synpunkt skall förarens kraft, som verkar på bromspedalen, vara så liten som möjligt. Reglerslaget hos bromspedalen skall också vara så litet som möjligt.

20 De bromssystem som hittills anordnats på entreprenadmaskiner innefattar två eller flera av varandra oberoende bromskretsar, som styrs av en bromsventil. Bromsventilen är kopplad till bromspedalen, som vid påverkan av en kraft från föraren öppnar ventilen, så att hydraulolja under tryck flödar till bromsorgan, som är anordnade vid maskinens
25 hjulaxlar eller hjul. Bromsorganen innefattar en kolv, som under trycket från hydrauloljan flyttas och pressar ett bromsbelägg 7 mot en bromsskiva. När föraren släpper bromspedalen upphör trycket på bromskolven 5 och bromsbelägget 7 förskjuts till ett utgångsläge med hjälp av retur fjädrar.

30 När föraren trycker på bromspedalen och därmed öppnar bromsventilen tar det en viss tid att förflytta bromskolven 5 från utgångsläget till det läge, som bromskolven 5 erhåller när bromsbelägget anligger mot bromsskivan. Denna tid kallas för bromsens

anbringningstid. När bromskolven nått detta senare läge börjar trycksättningen av hydrauloljan mot bromskolven, vilket leder till en kraftig trycköversläng i form av en tryckpuls hos hydrauloljan. Denna trycköversläng ger upphov till ett bromshugg, det vill säga en kraftig retardation av maskinen under kort tid, som av föraren upplevs som en stöt. Trycköverslängen ger också upphov till att komponenter i bromsorganen utsätts för kraftiga påkänningar, vilket bland annat alstrar oljud. Stötarna och oljuden upplevs som irriterande av maskinens förare.

Vid en mjuk bromsmanöver måste kraften på bromspedalen vara liten. Om maskinen färdas på ett ojämnt underlag, så att maskinen hoppar och rister, blir det svårt för föraren att reglera bromsanordningen med bromspedalen, så att en mjuk bromsmanöver erhålls. Maskinens retardation kommer då att variera, varför föraren upplever bromsanordningen svårreglerad. För att god reglerbarhet hos bromsanordningen skall erhållas skall anbringningstiden vara så kort som möjligt och trycköverslängen vara så liten som möjligt. Kort anbringningstid erhålls genom stort flöde hos hydrauloljan genom bromsventilen, men ju större flöde hos hydrauloljan, desto större blir trycköverslängen.

Ett syfte med föreliggande uppfinning är att åstadkomma en bromsanordning, som är anpassad för en entreprenadmaskins olika driftsförhållanden, så att stötar och oljud hos maskinen undviks vid inbromsning av maskinen.

Ett annat syfte med uppfinningen är att åstadkomma en bromsanordning, som uppvisar liten känslighet vid mjuka inbromsningar.

Detta åstadkommes med en bromsanordning av i inledningen angivet slag i vilken ett i den första eller andra bromskretsen anordnat begränsningselement begränsar hydrauloljans tryck och/eller flöde när bromsventilen styr hydrauloljan från tryckkällan till bromsorganen vid hjulaxlarna.

Begränsningselementet bidrar till att bromsverkan vid början av inbromsningsförloppet minskar hos den ena hjulaxeln, vilket därmed minskar bromsanordningens känslighet. När föraren trycker ner bromspedalen mjukt för att utföra en mjuk inbromsning kommer inget eller ett litet flöde av hydraulolja att uppkomma i den bromskrets, som
5 är försedd med begränsningselementet, samtidigt som ett stort flöde av hydraulolja kommer att flöda i den bromskrets som inte är försedd med ett begränsningselement. Efter det att en viss tid förflutit eller efter det att hydrauloljans tryck uppnått ett förutbestämt tryck kommer trycksättningen av bromsorganet vid den hjulaxel som från början hade reducerad bromsverkan att öka bromsverkan på denna hjulaxel. Vid exempelvis en panikbromsning kommer fordonets alla hjulaxlar att bromsas omedelbart
10 när föraren trycker på bromspedalen.

Uppfinningen skall i det följande förklaras närmare med hjälp av på bifogade figurer visade utföringsformer, på vilka

15 fig. 1 visar hydraultrycket som funktion av tiden vid aktivering av en känd bromsanordning,

fig. 2 visar en första utföringsform av en bromsanordning enligt föreliggande uppfinning,

fig. 3 visar en bromsventil för bromsanordningen enligt föreliggande uppfinning,

20 fig. 4 visar en andra utföringsform av en bromsanordning enligt föreliggande uppfinning,

fig. 5 visar en tredje utföringsform av en bromsanordning enligt föreliggande uppfinning, och

fig. 6 visar en fjärde utföringsform av en bromsanordning enligt föreliggande uppfinning.
25

Fig. 1 visar en graf över hur hydraultrycket varierar när en känd bromsanordning aktiveras. Den horisontella axeln anger tiden T och den vertikala axeln anger trycket P . Såsom nämnts i beskrivningsinledningen tar det en viss tid t_1 att förflytta en bromskolv från ett utgångsläge till ett läge, som bromskolven erhåller när ett bromsbelägg,
30 kolv från ett utgångsläge till ett läge, som bromskolven erhåller när ett bromsbelägg, mot vilket bromskolven pressar, anligger mot en bromsskiva. När bromskolven befin-

ner sig i detta senare läge påbörjas trycksättningen av hydrauloljan mot bromskolven, vilket leder till en kraftig trycköversläng i form av en tryckpuls hos hydrauloljan.

Trycksättningen sker under tidsperioden t_2 . Trycköverslängen ger upphov till ett bromshugg, det vill säga en kraftig retardation av maskinen under kort tid, som av fö-
5 raren upplevs som en stöt. Det har också visat sig att oljud uppkommer i bromsanordningen till följd av nämnda trycköversläng.

Fig. 2 visar en första utföringsform av en bromsanordning 1 enligt föreliggande uppfinning. Bromsanordningen 1 innefattar en första bromskrets 2, som är kopplad till ett
10 första bromsorgan 4 vid en första hjulaxel 6 hos en entreprenadmaskin. Bromsorganet 4 innefattar en vid varje hjul anordnad bromskolv 5, som via ett eller flera bromsbelägg 7 samverkar med en på hjulaxeln 6 förbunden bromsskiva (inte visad). Bromsanordningen 1 innefattar också en andra bromskrets 8, som är kopplad till ett andra
15 bromsorgan 10 vid en andra hjulaxel 12 hos maskinen. Efter ansättning av bromsanordningen är de första och andra bromskretsarna 2, 8 oberoende av varandra, vilket innebär att trycket i den ena kretsen 2, 8 inte påverkar hydrauloljans tryck i den andra kretsen 2, 8. Om den ena kretsen 2, 8 fallerar kan entreprenadmaskinen fortfarande bromsas med hjälp av den andra kretsen 2, 8. En tryckkälla 14 för hydraulolja är kopplad till den första och andra bromskretsen 2, 8. Tryckkällan 14 kan exempelvis
20 utgöras av en hydraulpump och/eller en eller flera hydraulackumulatorer (inte visat). En bromsventil 16 är kopplad till den första och andra bromskretsen 2, 8, vilken bromsventil 16 är utformad att styra hydrauloljan från tryckkällan 14 till bromsorganen 4, 10 vid hjulaxlarna 6, 12. I den andra bromskretsen 8 är ett begränsningselement i form av en sekvensventil 18 anordnad.

25 När bromsventilen 16 styr hydrauloljan från tryckkällan 14 till bromsorganen 4, 10 vid hjulaxlarna 6, 12 kommer sekvensventilen 18 att begränsa hydrauloljeflödet till det andra bromsorganet 10 om trycket hos hydrauloljan understiger ett förutbestämt tryck. Denna begränsning kan innebära att ingen eller lite hydraulolja flödar genom sekvens-
30 ventilen 18. Sekvensventilen 18 öppnar när hydrauloljans tryck uppnår ett förutbe-

stämt tryck, så att ett stort hydrauloljeflöde genom sekvensventilen 18 uppkommer. Sekvensventilens 18 funktion kan således liknas vid en övertrycksventils funktion.

När bromsanordningen 1 avaktiveras skall hydrauloljan i bromsorganen 4, 10 dräneras, vilket innebär att hydrauloljan skall strömma i riktning från bromsorganen 4, 10 till bromsventilen 16 och vidare till en tank 20. För att åstadkomma detta är en första bypass-ledning 22 ansluten över sekvensventilen 18, så att hydraulolja medges att passera förbi sekvensventilen 18. En backventil 24 är anordnad i den första bypass-ledningen 22, så att hydraulolja förhindras att flöda genom den första bypass-ledningen 22 i riktning mot det andra bromsorganet 10.

Enligt den första utföringsformen innefattar bromsventilen 16 en första och andra slidventil 26, 28, vilka påverkas av en bromspedal 30. När bromspedalen 30 trycks ned öppnas den första och andra slidventilen 26, 28, så att hydraulolja flödar från tryckkällan 14 mot de första och andra bromsorganen 4, 10. Företrädesvis är det trycket i den första bromskretsen 2, som påverkar öppningen av den andra slidventilen 28, vilket antyds med en kanal 29 mellan den första bromskretsen 2 och den andra slidventilen 28.

Alternativt kan de första och andra slidventilerna 26, 28 samt sekvensventilen 18 och den första bypassledningen 22 med backventilen 24 ersättas med en bromsventil 16', som visas i fig. 3. Denna bromsventil 16' innefattar en första slid 32, som styr hydrauloljans flöde i den första bromskretsen 2 och en andra slid 34, som styr hydrauloljans flöde i den andra bromskretsen 8. Den första sliden 32 är anordnad att styra den andra sliden 34, så att den andra sliden 34 öppnar den andra bromskretsen 8 när trycket i den första bromskretsen 2 uppnått ett förutbestämt tryck. Detta förutbestämda tryck bestäms av fjäderkraften hos en första fjäder 36 hos bromsventilen 16'. Den första sliden 32 är förbunden med bromspedalen 30 och när bromspedalen 30 trycks ned kommer den första sliden 32 att förskjutas i bromsventilen 16', så att den första bromskretsen 2 öppnas. En mellan den första och andra sliden 32, 34 anordnad andra fjäder 38 tillser att den andra sliden 34 från början inte förskjuts av den första sliden

32. När den första sliden 32 har förskjutits så långt att den första kretsen 2 öppnats kommer hydrauloljan i en första grenledning 33 till kretsen 2 att trycksätta utrymmet mellan sliderna 32, 34. När trycket i den första kretsen 2 övervinner den första fjäderns 36 kraft, som verkar på den andra sliden 34 kommer den andra sliden 34 att öppna den andra kretsen 8. En andra grenledning 35 i den andra kretsen 8 leder hydraulolja till den ände av den andra sliden 34, som är vänd mot den första fjädern 36. När trycket i den andra kretsen 8 tillsammans med kraften från den första fjädern 36 övervinner trycket i den första kretsen 2 kommer den andra sliden 34 att stänga den andra kretsen 8. Därmed kommer trycket i den andra kretsen 8 att bli lägre än trycket i den första kretsen 2. Skillnaden mellan trycken i den första och andra kretsen 2, 8 beror på storleken hos den första fjäderns 36 fjäderkraft. Den första fjädern 36 kommer därmed att fungera som ett begränsningselement.

Om bromspedalen 30 enbart trycks ned en liten sträcka, för att en mjuk inbromsning skall utföras, kommer enbart den första hjulaxeln 6 att bromsas. Vid en kraftigare inbromsning måste den första fjäderns 36 kraft att övervinnas, så att båda bromskretsarna 2, 8 öppnas, vilket innebär att båda hjulaxlarna 6, 12 bromsas. Om en av kretsarna 2, 8 skulle falla och hydraultryck i en av kretsarna 2, 8 skulle saknas vid ansättning av bromsanordningen 1 kan bromspedalen 30 tryckas ned så pass mycket att den andra fjädern 38 sammanpressas, vilket medför att även den andra sliden 34 kommer att förskjutas, så att den andra bromskretsen 8 öppnas.

I fig. 4 visas en andra utföringsform av uppfinningen. Vid denna utföringsform är en andra bypass-ledning 40 anordnad över sekvensventilen 18. I den andra bypass-ledningen 40 är en strypventil 42 anordnad, vilket innebär att ett begränsat flöde av hydraulolja alltid kan passera förbi sekvensventilen 18. Med hjälp av det begränsade hydrauloljeflödet kommer det andra bromsorganet 10 att långsamt aktiveras och bromsa den andra hjulaxeln 12 vid en mjuk inbromsning när trycket hos hydrauloljan inte uppnår det förutbestämda trycket vid vilket sekvensventilen 18 öppnar. Således erhålles en fördröjning av inbromsningen av den andra hjulaxeln 12.

Enligt en tredje utföringsform, som visas i fig. 5, är det tänkbart att enbart förse den andra bromskretsen 8 med en strypventil 42', så att en fördröjning av bromsningen av den andra hjulaxeln 12 uppkommer. Strypventilen 42' utgör här ett begränsningselement. På så vis förhindras bromshugg vid mjuk inbromsning av maskinen. Det är också tänkbart att, enligt en fjärde utföringsform i fig. 6, anordna den första bypassledningen 22 med en backventil 24 över strypventilen 42' i den andra bromskretsen 8. Därmed erhålles en snabb dränering av det andra bromsorganet 10 när bromsanordningen 1 avaktiveras.

- 10 Ovan har en bromsanordning 1 med två bromskretsar 2, 8 beskrivits. Det är dock möjligt att utföra bromsanordningen 1 med tre eller flera bromskretsar. Det är också möjligt att anordna begränsningselementet 18, 42' i den första bromskretsen 2 istället för i den andra bromskretsen 8. Den första hjulaxeln 6 kan vara en framaxel och den andra hjulaxeln 12 kan vara en bakaxel hos maskinen eller omvänt.

Patentkrav

1. Bromsanordning för en entreprenadmaskin, innefattande

en första bromskrets (2), som är kopplad till ett första bromsorgan (4) vid en första

5 hjulaxel (6) hos maskinen,

en andra bromskrets (8), som är kopplad till ett andra bromsorgan (10) vid en andra

hjulaxel (12) hos maskinen, vilka första och andra bromskretsar (2, 8) är oberoende av
varandra,

10 en tryckkälla (14) för hydraulolja, som är kopplad till den första och andra bromskretsen (2, 8), och

en bromsventil (16, 16'), som är kopplad till den första och andra bromskretsen (2, 8),

vilken bromsventil (16, 16') är utformad att styra hydrauloljan från tryckkällan (14) till
bromsorganen (4, 10) vid hjulaxlarna (6, 12),

kännetecknad av

15 ett i den första eller andra bromskretsen (2, 8) anordnat begränsningselement (18, 36, 42'), som begränsar hydrauloljans tryck och/eller flöde när bromsventilen (16, 16') styr hydrauloljan från tryckkällan (14) till bromsorganen (4, 10) vid hjulaxlarna (6, 12).

20 2. Bromsanordning enligt krav 1, **kännetecknad av** att begränsningselementet innefattar en sekvensventil (18), som öppnar när hydrauloljans tryck uppnår ett förutbestämt tryck.

25 3. Bromsanordning enligt något av kraven 1 eller 2, **kännetecknad av** att begränsningselementet innefattar en strypventil (42'), som begränsar hydrauloljans flöde.

4. Bromsanordning enligt något av kraven 2 eller 3, **kännetecknad av** att en första bypass-ledning (22) är ansluten över begränsningselementet (18, 42'), så att hydraulolja medges att passera förbi begränsningselementet (18, 42') och att en backventil
30 (24) är anordnad i den första bypass-ledningen (22), så att hydraulolja förhindras att flöda genom den första bypass-ledningen (22) i riktning mot bromsorganet (4, 10).

5. Bromsanordning enligt krav 2, **kännetecknad av att en andra bypass-ledning (40)** är ansluten över sekvensventilen (18) och att en strypventil (42) är anordnad i den andra bypass-ledningen (40), så att hydraulolja med ett begränsat flöde kan passera
5 förbi sekvensventilen (18).

6. Bromsanordning enligt krav 1, **kännetecknad av att bromsventilen (16') innefattar** nämnda begränsningselement (36).

10 7. Bromsanordning enligt krav 6, **kännetecknad av att bromsventilen (16') innefattar** en första slid (32), som styr hydrauloljans flöde i den första bromskretsen (2) och en andra slid (34), som styr hydrauloljans flöde i den andra bromskretsen (8), vilken första slid (32) är anordnad att styra den andra sliden (34), så att den andra sliden (34)
15 öppnar den andra bromskretsen (8) när trycket i den första bromskretsen (2) uppnått ett förutbestämt tryck.

8. Bromsanordning enligt krav 7, **kännetecknad av att begränsningselementet innefattar** en första fjäder (36), som verkar på den andra sliden (34).

20 9. Bromsanordning enligt något av föregående krav, **kännetecknad av att en till** bromsventilen (16, 16') kopplad bromspedal (30) är anordnad att styra bromsventilen (16, 16').

Sammandrag

Uppfinningen avser bromsanordning (1) för en entreprenadmaskin, innefattande en första bromskrets (2), som är kopplad till ett första bromsorgan (4) vid en första
5 hjulaxel (6) hos maskinen, en andra bromskrets (8), som är kopplad till ett andra bromsorgan (10) vid en andra hjulaxel (12) hos maskinen, vilka första och andra bromskretsar (2, 8) är oberoende av varandra, en tryckkälla (14) för hydraulolja, som är kopplad till den första och andra bromskretsen (2, 8), och en bromsventil (16, 16'),
10 16') är utformad att styra hydrauloljan från tryckkällan (14) till bromsorganen (4, 10) vid hjulaxlarna (6, 12). Den första eller andra bromskretsen (2, 8) innefattar begränsningsselement (18, 42'), som begränsar hydrauloljans tryck och/eller flöde när bromsventilen (16, 16') styr hydrauloljan från tryckkällan (14) till bromsorganen (4, 10) vid hjulaxlarna (6, 12).